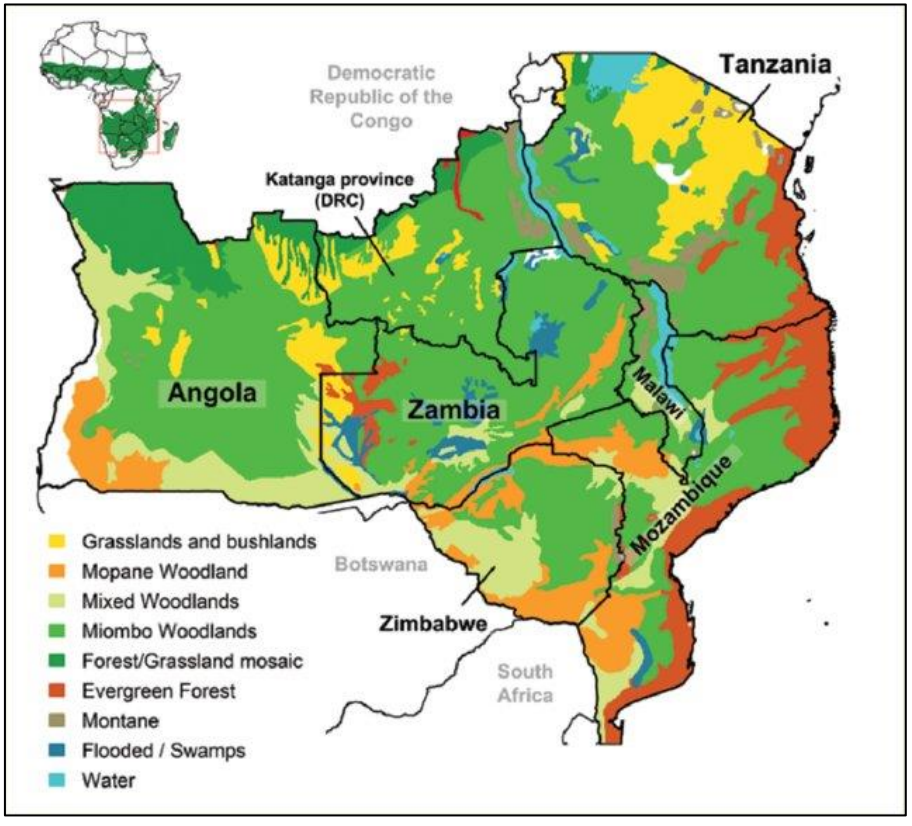
Miombo research in Angola, present situation and perspectives

Francisco M.P. Gonçalves

Miombo Network Meeting, 3 - 4 June

Forest cover in Angola

- Angola forest cover (57.85 M ha)
- Moist tropical forest (only 2%)
- Forest mosaic, incl. Miombo (ca. 62.8%)



Ryan et al. 2016

Scientific research in Angola

Angola harbours an rich and exceptional biodiversity;

Actually ca. 6850 plants species, including many endemics;

Most of them were documented from the Angolan miombo ;

Unfortunately historical factors hampered the progress of scientific research Angola;

Scientific research in Angola

Recent initiatives have contributed significantly to actual knowledge of the Angolan miombo;

TFO - The Future Okavango Project and SASSCAL covered areas of the Okavango basin in Angola, Namibia and Botswana and other woodlands in Zambia and South Africa;

Threats to miombo woodlands


Shifting cultivation


Construction of roads


Charcoal production

Röder et al. (2015); Gonçalves et al. (2017); Chiteculo et al. (2019)

Threats to other woodlands

Logging


Conversion to agriculture


Fires

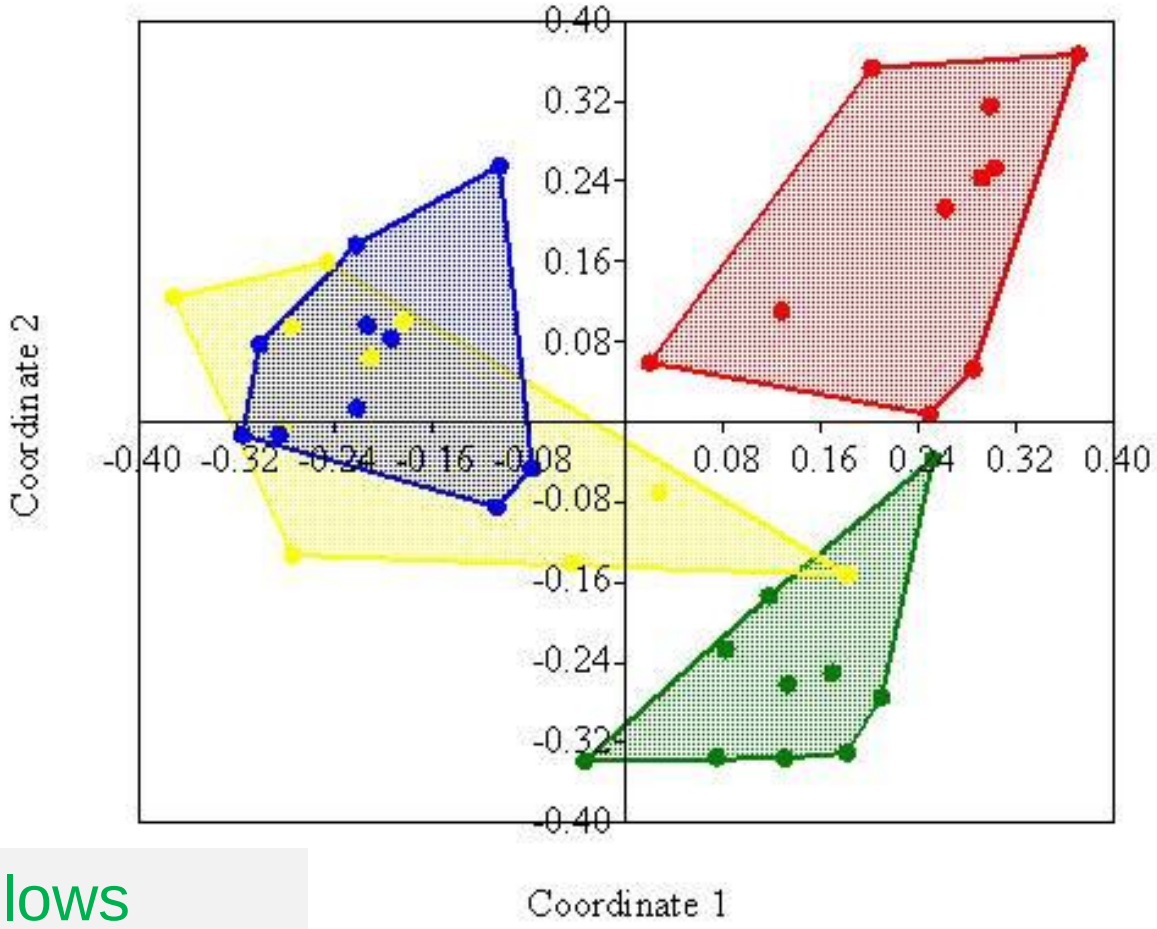
Stellmes et al. (2013); De Cauwer et al. (2018); Chiteculo et al. (2018)

Shifting cultivation

Site selection

Felling of trees

Forest recovery after cultivation



Young fallows
Medium fallows
Old fallows
Mature woodlands

Gonçalves et al. 2017

The underground forests of the Bié plateau

Within miombo there are another formation, characterized by species developing anual aerial parts and enormous underground woody parts - so called “geoxyles”, “geoxylic suffrutices” or “anharas de ongote” in Angola.

The underground forests of the Bié plateau

Differences in key PFTs between trees and geoxyles reflect both life form specific adaptations to hostile environmental conditions and lineage-specific strategies to cope with environmental stresses

Full paper

New Phytologist

Check for updates

Functional traits and symbiotic associations of geoxyles and trees explain the dominance of detarioid legumes in miombo ecosystems

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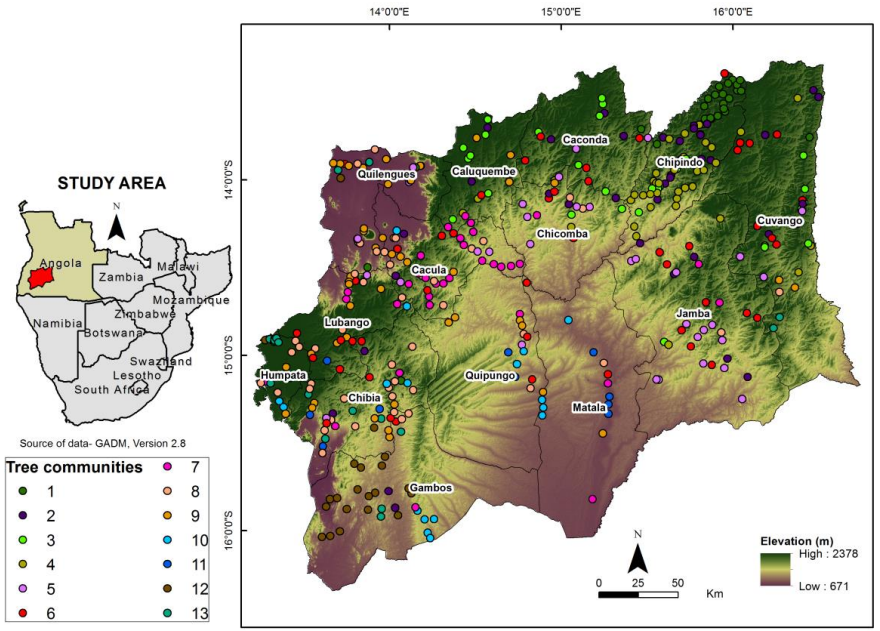
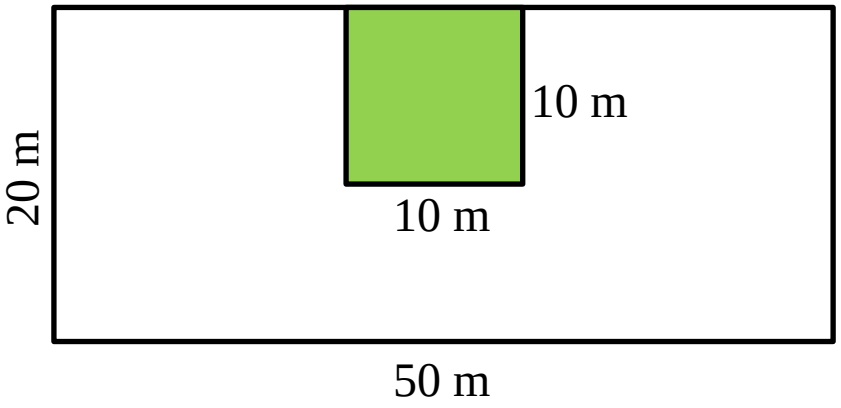
Key words: ectomycorrhiza, Fabaceae Detarioideae, geoxyles, geoxylic grasslands, Rhizobia, trait-based plant strategies, trees.

Summary

- The miombo region in Africa is covered by a mosaic of woodlands and geoxylic grasslands and is subject to disturbances such as fires, frost and drought, and low nutrient availability. The dominance of Fabaceae Detarioideae species in miombo ecosystems is remarkable but little understood. We therefore compared plant functional traits (PFTs) of common woody species of the Angolan plateau, grouped by life form (trees, geoxyles), lineage (Fabaceae: Detarioideae, non-Detarioideae) and symbiont association (ectomycorrhiza, rhizobia).
- PFTs reflect group-specific adaptations to prevalent environmental conditions. To analyse the impact of environmental drivers, we selected PFTs reflecting ecophysiological aspects of leaf morphology, nutrient content and water transport. Traits were measured following standardized protocols.
- We found differences in key PFTs between trees and geoxyles reflecting both life form-specific adaptations to environmental conditions and lineage-specific strategies to cope with environmental stresses. We interpret higher leaf thickness and higher wood density of geoxyles as responses to harsher open environments. Fabaceae in general and ectomycorrhizal species showed better nutrient status.
- Symbiotic associations of detarioid legumes with ectomycorrhiza show specific advantages

Surveying the woodlands of Huíla province

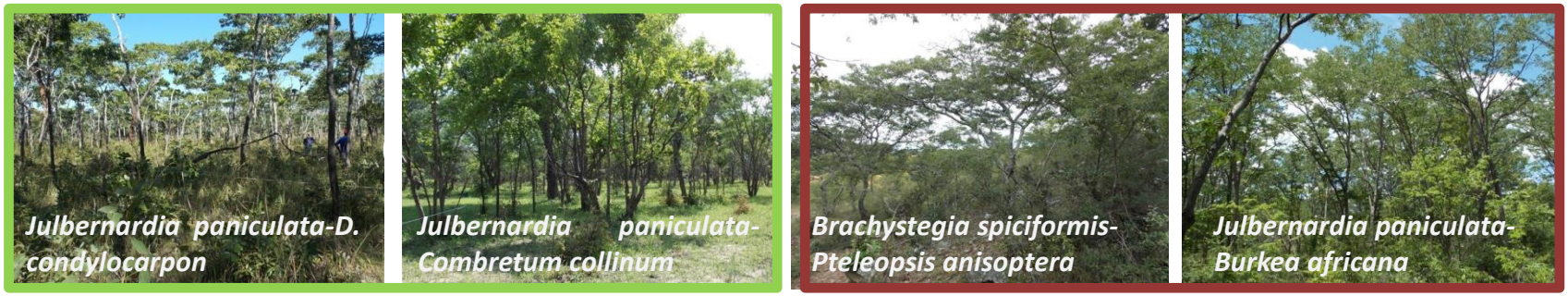


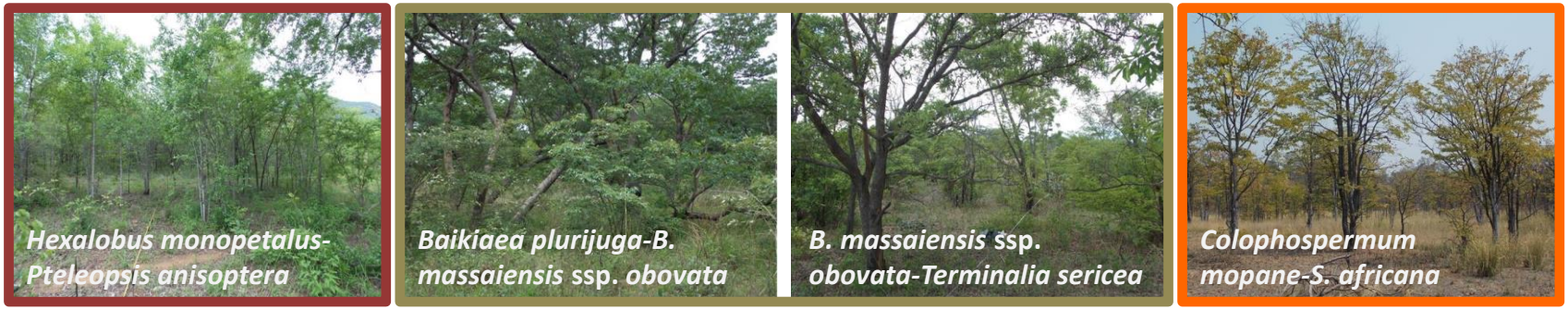


- Vegetation surveyed in a total of 456 plots, all trees with (DBH ≥ 5 cm) were measured;
- Classification using ISOPAM (clustering) to describe tree communities;
- Diagnostic species were determined using phi_coeficient (threshold ≥ 30 and *p-value* < 0.05);

Chisingui et al. 2018

Classification of the woodlands





Miombo

Julbernardia

semiarid woodlands

Baikiaea-Burkea

Mopane

Chisingui et al. 2018

First vegetation database of the woodlands of Huíla province

GIVD Database ID: AF-AO-001 **Last update:** 2021-05-17

Vegetation-Plot Database of Woody Species from Huíla Province

Web address: http://iwww.givd.info/ID/AF-AO-001

Database manager(s): Francisco Gonçalves (francisco.goncalves@isced-huila.ed.ao); António Chisingui (valter.chissingui@isced-huila.ed.ao); José Tchamba (jose.tchamba@isced-huila.ed.ao)

Owner: ISCED-Huíla, Rua Sarmento Rodrigues, N.º 2, C.P. 230, Lubango-Angola

Scope: The database contains information on diversity, abundance and diameter (DBH>5 cm) of woody species from the woodlands of Huíla province, Angola. The species were locally identified based on familiarity of team members with local/regional flora or using the available field guides.

Availability: according to a specific agreement		**Online upload:** no	**Online search:** no
Database format(s): Excel		**Export format(s):** Excel, CSV file	
Plot type(s): nested plots		**Plot-size range (m²):** 100 to 1000	
Non-overlapping plots: 448	**Estimate of existing plots:** 448	**Completeness:** 100%	**Status:** completed and continuing
Total no. of plot observations: 448	**Number of sources (biblioreferences, data collectors):** 0		**Valid taxa:** 193

Countries (%): AO: 100%

Formations: Forest: 100% = Terrestrial: 100%

Guilds: [NA]

Environmental data (%): altitude: 100%; slope inclination: 100%; surface cover other than plants (open soil, litter, bare rock etc.): 100%; land use categories: 100%; soil depth: 100%; other attributes: At least one soil sample per plot was collected, depth depends on soil characteristic.

Performance measure(s): presence/absence only: 100%; number of individuals: 100%; measurements like diameter or height of trees: 100%

Geographic localization: GPS coordinates (precision 25 m or less): 100%

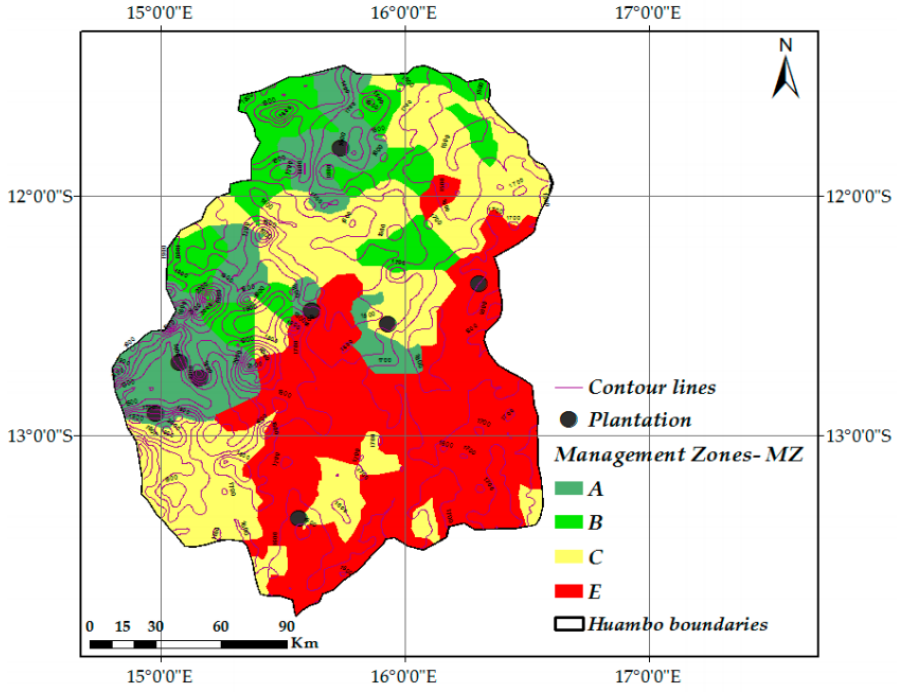
Sampling periods: 2010-2019: 100%

Information as of 2021-05-17; further details and future updates available from http://www.givd.info/ID/AF-AO-001

http://www.givd.info/ID/AF-AO-001

Gonçalves et al. submitted

Forest management planning in miombo forest, case study Huambo province, Angola

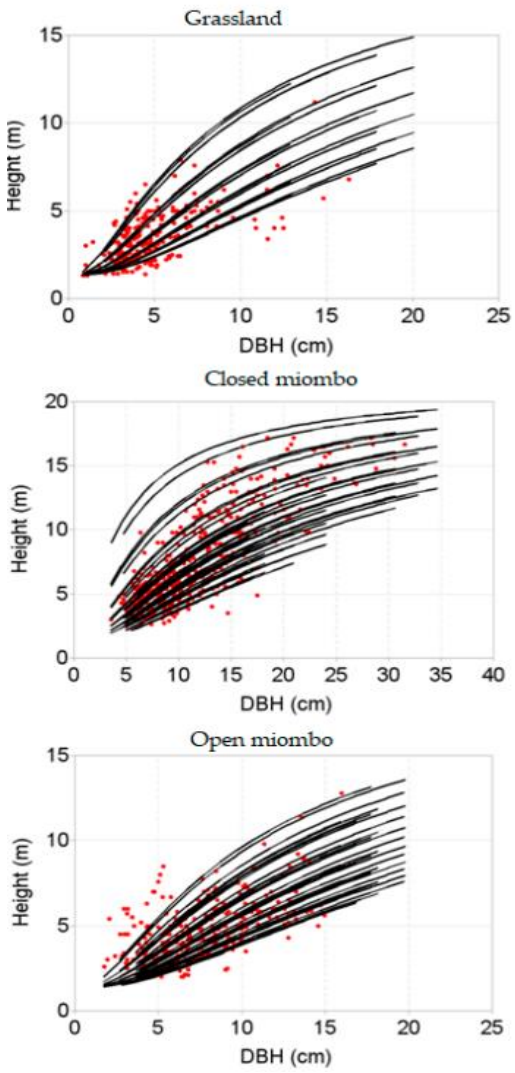


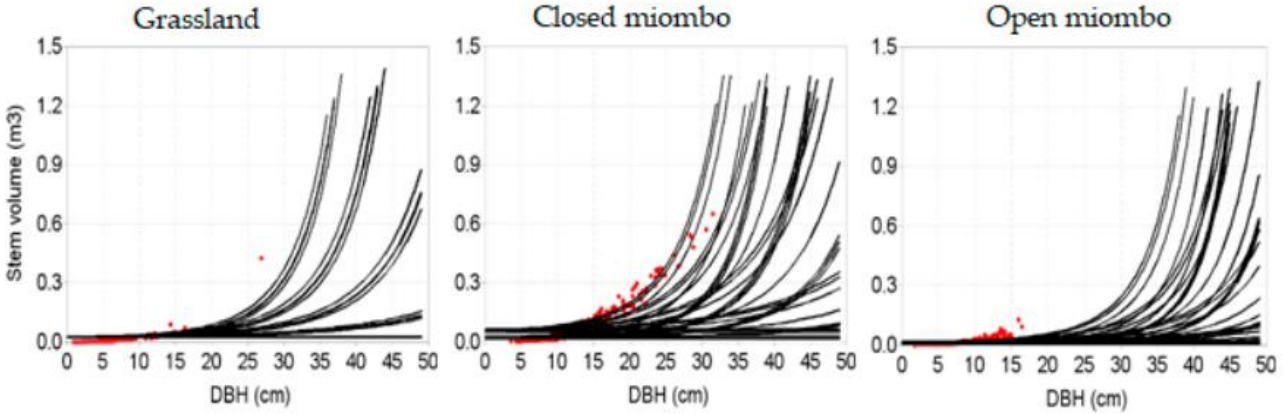
Four management zones (MZ) aligned based on topographic attributes

MANAGEMENT ZONES	MAIN FEATURES
Plantations	Eucalyptus and Pinus Experience of disturbance
MZ - A	Closed miombo, undisturbed Protected areas or private No management treatment
MZ – B	Opened miombo, overlaps with MZ - C Production of firewood, charcoal etc… Cleared or cultivated
MZ - C	Grassland/Savannas, overlaps with MZ-D Agricultures activities
MZ - E	Agriculture lands in uphills, Evidence of post abandoned areas, cutting remained trees for firewood

Chiteculo & Surovy, 2018

Forest management planning in miombo forests, case study Huambo province, Angola

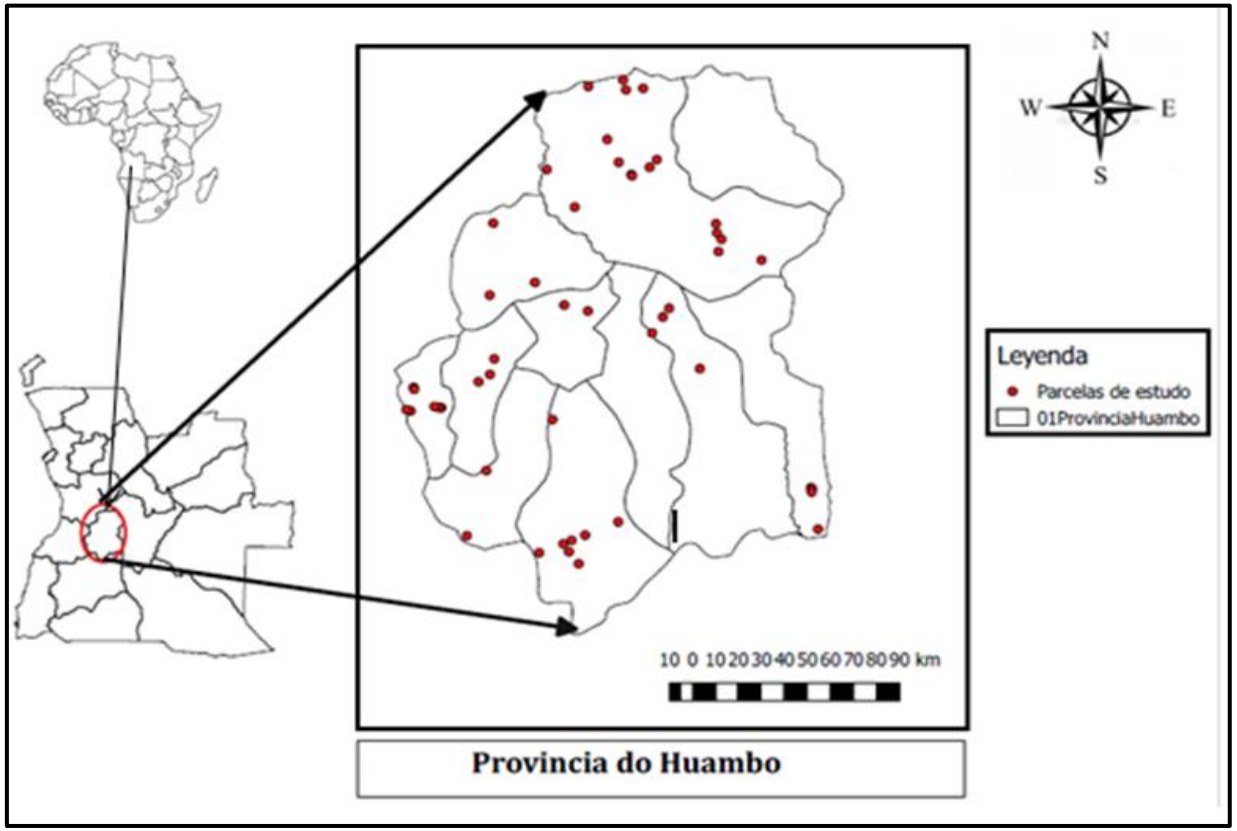




Pattern of height-diameter and stem volume for miombo species, shows faster increase in earlier stages and slower in later stages (Naslund function model)

Chiteculo et. al. 2018

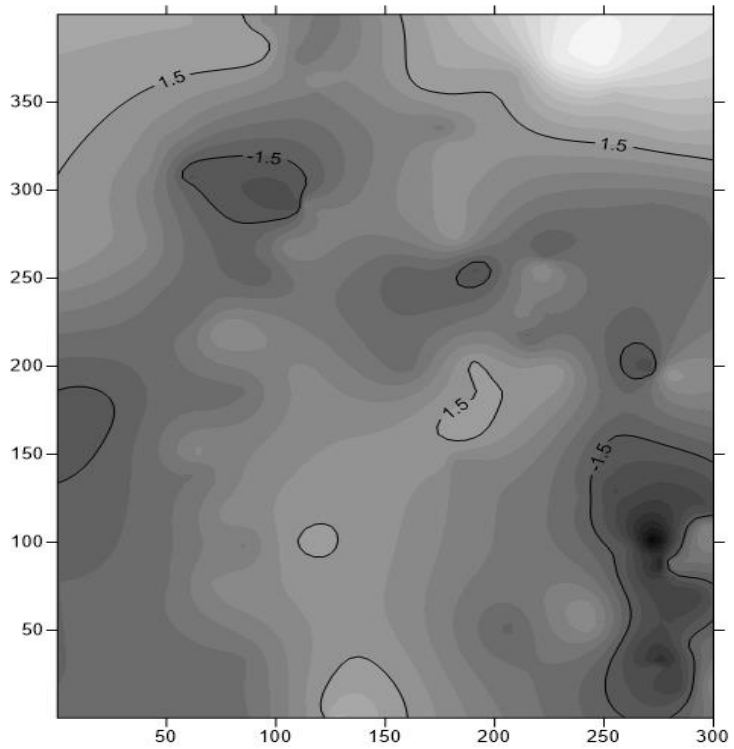
Descriptive study of the different ecological variables of Miombo in Huambo province, Angola



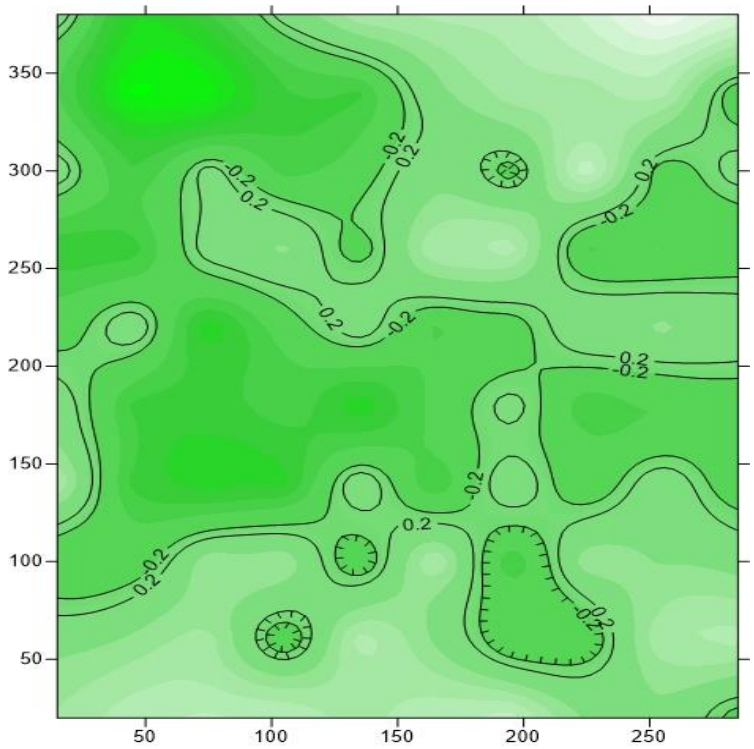
Semi-random distribution of 49 veg_plots in the Central Angola Plateau, Huambo province

Miápia data, 2020

Ecological Distribution Patterns



Distribution pattern of adult individuals in the plots

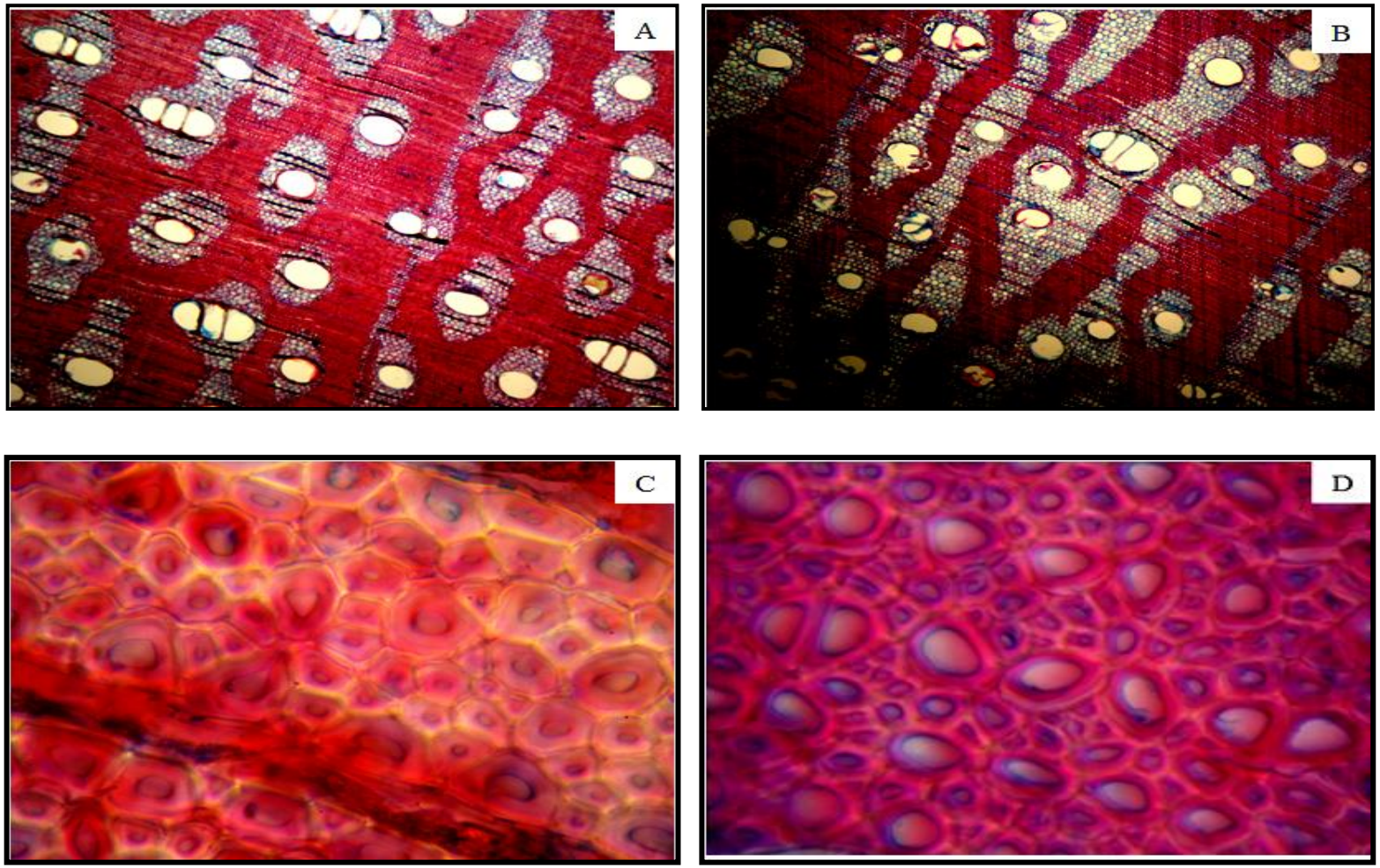


Influence of canopy fraction on natural regeneration

la > 1: Aggregate spatial pattern; la = 1: Random spatial pattern; la < 1 Regular spatial pattern

Miápia data. 2020

Evaluation of the pulpability of some species from the Angolan miombo woodlands



Transversal sections of *B. spiciformis* sapwood and heartwood at 4X (A and B), sapwood and heartwood at 100X (C and D)

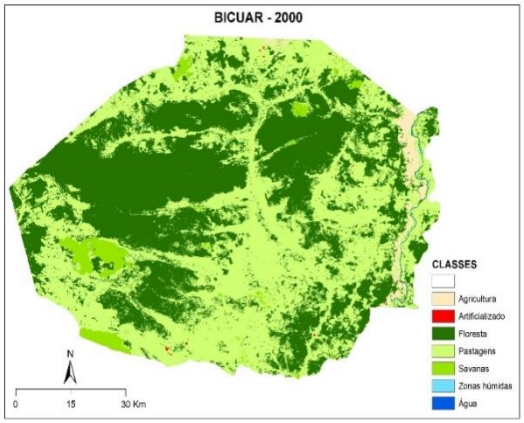
Sangumbe et al. 2018

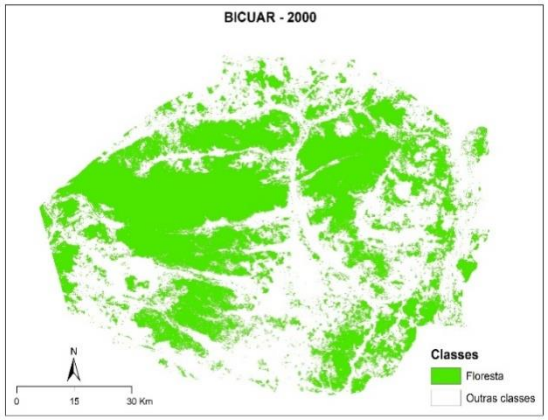
Chemical composition of wood from *B. spiciformis* and *P. angolensis*

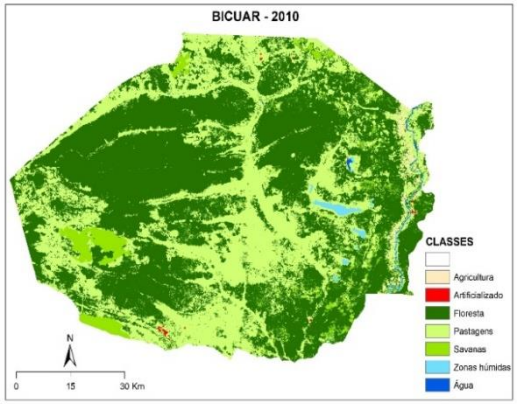
Components (%)	*B. spiciformis*	*P. angolensis*
Cellulose	$50,1^{a} \pm 1,07$	$41,9^{b} \pm 2,12$
Hemicelluloses	$17,6^{b} \pm 0,78$	$26,5^{a} \pm 2,19$
Arabinose	$0,04^{b} \pm 0,07$	$1,04^{a} \pm 0,27$
Mannose	$0,36^{b} \pm 0,08$	$1,24^{a} \pm 0,09$
Xylose	$12,45^{b} \pm 0,05$	$14,58^{a} \pm 0,09$
Glucose	$0,11^{b} \pm 0,07$	$3,38^{a} \pm 0,35$
Galactose	$0,09^{b} \pm 0,07$	$1,37^{a} \pm 0,14$
Rhamnose	$0,04^{b} \pm 0,08$	$1,28^{a} \pm 0,28$
Uronic groups	$4,52^{a} \pm 0,64$	$3,58^{b} \pm 1,06$
Acetone/water extractives	$5,6^{a} \pm 0,24$	$4,6^{a} \pm 0,95$
Lignin	$22,5^{b} \pm 0,7$	$29,2^{a} \pm 0,22$
Holocellulose	$68,0^{a} \pm 0,37$	$67,7^{a} \pm 1,09$
Alpha-cellulose	$49,3^{a} \pm 1,8$	$40,0^{b} \pm 1,58$
Lignin S/G ratio	$1,72^{a} \pm 0,07$	$0,89^{b} \pm 0,08$

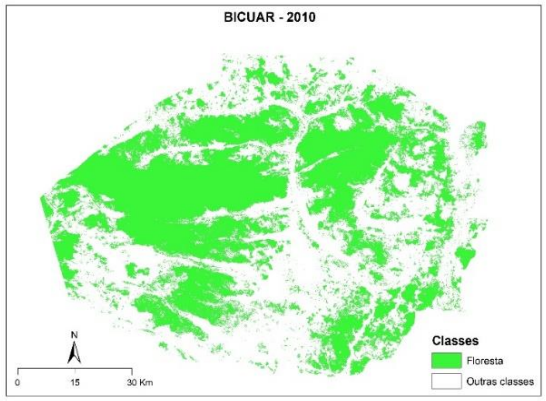
Different letters indicate significant differences between species ($p<0,05$).

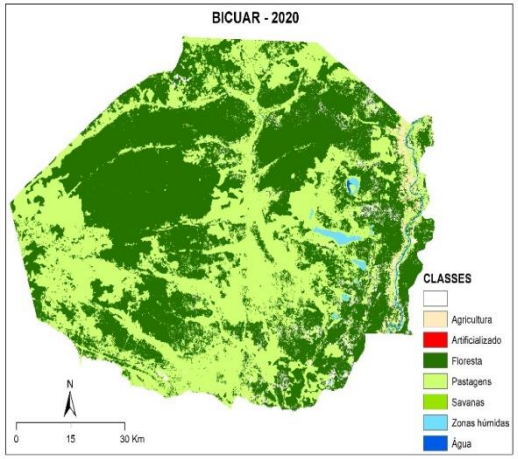
Sangumbe et al. 2018

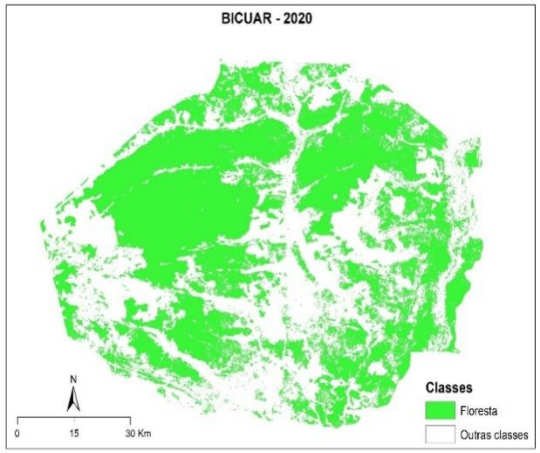












Deforestation increased up to 13,7% from 2000-2013 (Potapov et al. 2017)

Fires is showing an alarming trend in Conservation areas (Catarino et al. 2020)

Climate change will bring more frequent and intense droughts in many parts of Angola

Wivalço Gomes (unpub. master thesis)

Conclusion words-how the network can contribute to restoration in Angola

- Despite efforts made by the academia and scientific researches institution, there is a need for more studies;
- Miombo woodlands in Angola are threatened by increasing human activities;
- Adding to that the Angolan government have changed the law, which now authorises exploitation of natural resourses in conservation areas;
- This include the Okavango basin, where important oil reserves have been discovered. So, there is an urgent need for restoration actions to mantain important ecosystem services and functions;

UNITED NATIONS DECADE ON
ECOSYSTEM
RESTORATION
2021-2030

THANK YOU FOR YOUR ATTENTION

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